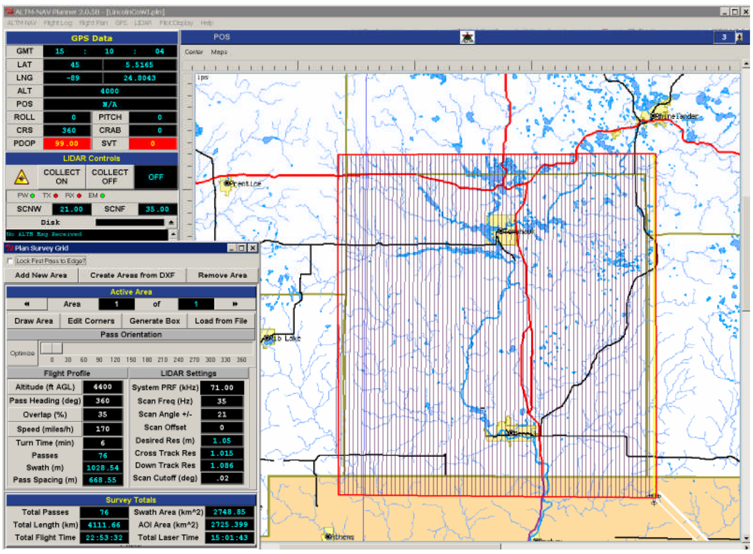
Barron County Wisconsin LIDAR PROJECT
PROJECT REPORT

Introduction
LMSI was contracted to perform a LIDAR survey of Lincoln County Wisconsin. The project consisted of airborne LIDAR data collection, aerial photo acquisition, GPS control for the LIDAR survey and aerial photography, GPS and conventional survey for ground truthing and quality assurance of the LIDAR bald earth DTM, and LIDAR mapping of the project area.

LIDAR Data Acquisition
The project consisted of 1 flight area encompassing the county of Lincoln Wisconsin with an additional 1-mile collar extended outside of the county boundary. Eight LIDAR survey missions were conducted to complete the Lincoln County Wisconsin LIDAR survey project. LIDAR data collection commenced on May 26, 2008 and concluded on June 10, 2008, with a small re-flight conducted on August 10, 2008. Airborne navigation for the flight was from the airborne GPS system integrated with the Optech ALTM LIDAR system called ALTM NAV. The flight boxes shown below are from a screen capture from the ALTM NAV system. There were a total of 76 flight lines to complete the flight plus a calibration line with each flight session.



Laser Firing Rate:	70000
Altitude (ft. AGL):	4400
Swath Overlap (%):	35
Approx. Ground Speed (mph):	170
Scan Rate (Hz):	35
Scan Angle (°±):	21
Computed Along Track Spacing (ft):	3.5
Computed Cross Track Spacing (ft.):	3.5
Average Raw Point Spacing (ft.)	2.8
Computed Swath Width (ft.):	3378
Number of Lines Req'd:	76
Line Spacing (ft.)	2196

Base Stations
A total of (2) GPS base station monuments were used for the LIDAR flights. The same monuments were used for each flight. The monuments used were:

Lincoln County monument – Erma Hill

Offset to Lincoln County monument – Erma Hill

Survey Control
Forty ground control points (GCP) were established by Earth Mapping International to control the LIDAR mapping of the Lincoln County Project area

LIDAR Data Processing

Airborne GPS Trajectories
The airborne GPS trajectory solutions were processed in the field by our data acquisition team to insure we had high quality airborne trajectories, an important step in obtaining high accuracy in a LIDAR survey. Also, we kept our baseline lengths to less than 25 miles and planned our survey missions during times of low PDOP. Back in the office after data acquisition, we re-processed the airborne GPS to achieve the highest accuracy possible. The vertical RMS separation between the forward/reverse trajectory solutions ranged from 1cm-8cm. We use POS PAC software consisting of POS GPS and POS PROC for all airborne GPS processing. We use POS GPS to obtain the optimum trajectory solution and then run that solution through POS PROC that further refines the accuracy of the trajectory and smoothes the finished results. This completed trajectory solution is then output as an sbet file.

LIDAR System Calibration
We use the Optech suite of software called Dashmap for LIDAR x y z processing. In addition to the LIDAR system manufacturers' calibration, we do a flight calibration for each LIDAR mission. We re-fly all or a portion of one of the flight lines in each session in the opposite direction. We then process these two flight lines in Realm to x y z points and cross section each line over a flat surface. We use this information to compute new calibration values for roll and scale. Once we have obtained the optimum results for the calibration lines, we use these values in the Realm software to compute the laser points for each flight session. The completed raw laser points are output in UTM meter format.

Data Conversion
When we have completed processing the LIDAR data, microstation is used to convert data to the Geoid 03 model. We then use WISCON v2.2 to convert the LIDAR x y z i points to the Lincoln County Wisconsin coordinate system.

Vertical Adjustment of the LIDAR DTM
The completed LIDAR x,y,z,i points are imported into microstation/terrascan software by flight line, and all lines that flew over a GCP are noted in a spreadsheet with the control point value and difference. Preliminary adjustments are made to the flight lines called control lines, and then the remaining lines between the control lines are cross sectioned along roads and edge matched to tie in between control lines to within a few centimeters. Any areas that do not match to within a few centimeters are investigated. When all adjustment numbers and ties are complete and the flight lines adjusted to the control points, the LIDAR data is ready for vegetation removal.

LIDAR Data Classification

We use Terra Scan/ Terra modeler software for LIDAR data classification. The LIDAR flight lines imported into Terra Scan are then classified to a bald earth surface model. Various parameters and iterations are utilized until the optimum project classification parameters are determined. These numbers will be utilized and an overall classification of the project will be run with the data being separated into ground, vegetation and water classes.

Ortho-DEM Generation

A sub-15cm RMSE Ortho-DEM grid was created using the classified bald earth data for Ortho-rectification of the aerial photography. The Ortho-DEM was generated from the classified bald earth DTM points and gridded at 15 feet with no breaklines incorporated into the surface.

Breakline Generation

Breaklines are generated in microstation/terrascan. These breaklines are generated for water surfaces including rivers, lakes and ponds, to enhance the LIDAR data.

DTM Surface Model

We create a DTM surface model using the edited LIDAR classified bald earth points. We manually remove all erroneous points found in the data caused by multi path or water that were not addressed in processing.

Gridded Surface Model

A gridded bald earth surface model was generated from the edited LIDAR classified bald earth points incorporating the 3d breakline files into the surface. The surface was gridded at 4 feet and an x,y,z, point file exported by project tile. Surfaces were also converted to Esri grd raster format.

Contour Generation

Contours were generated by microstation/terrascan software at 2-foot increments from the Gridded Surface Model. Index contours were designated every 5th contour and were labeled with the respective elevation every 500 feet along the contour line.

Data Output

The LIDAR x y z i data for the first return and last return bald earth were imported into the Terra Scan project and output by project tiles. The classified bald earth x y z points were also output by project tiles and delivered as DTM files.

Summary

All the LIDAR flights were executed as planned. There were no unusual occurrences and all equipment operated normally. The LIDAR flights provided complete area coverage with no data holidays. All data voids in the bald earth points are from water surfaces. LIDAR points become more sparse in areas of dense vegetation, but typically are closer than 15 or 20 feet. No data anomalies were encountered. Data accuracy and quality is very good with an RMSE of 0.33 feet or 10cm at the 95% distribution.